THE EXPLOSIVES ENGINEER

REG. U.S. PAT. OFF.

Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

The construction of levees through Florida's Everglades, made up of heavy muck covered with swampy vegetation, poses difficult problems. Many innovations in the structure and use of equipment have to be introduced to operate successfully in the wet, mucky ground. Variable limestone formations have to be drilled and blasted in pits covered with water. The rapidity of change in the thickness and hardness of the rock layers, plus the flexibility of the formation, makes this submarine blasting extremely important.

A description of the operations of Hooper Construction Company in building 14.7 miles of levees 10 miles north of Hialeah, Florida, is presented in an article by Charles R. Sparf, beginning on page 175.

• • •

At Marriott-Reed Coal Company's property near Columbia, Missouri, banks of overburden 38 ft. high are drilled, blasted, and excavated to recover a 28-in. seam of high-quality coal. In removing the overburden, 4½-in.-diameter holes are drilled horizontally into the banks, with spacings on 20- to 30-ft. centers. The drill holes are column-loaded with Hercomite* 2 dynamite and the charges are detonated by means of electric blasting caps. Draglines are employed to remove the blasted material.

A summary of the operating procedures, including the development of a unique system for neutralizing the high acidity in the mine water, is presented by J. R. McCloskey, on page 180.

• • •

For the fourth consecutive year, Reliance No. 7 mine of The Union Pacific Coal Company made the best record in the National Safety Competition, in the bituminous-coal mine group. To pay tribute to the Reliance employes for their remarkable record of having worked 1,684,394 man-hours without a lost-time injury during four years, 1948 to 1951 inclusive, company officials were hosts to 550 miners, their wives and friends, at a gala dinner-ceremony in Rock Springs, Wyoming. For a review of the proceedings, please turn to page 184.

• • •

California's historic Kern Valley is the locale of a $21,710,000 combination flood-control, conservation, and recreation dam project, designated Isabella Dam. Although the dam is being built primarily of earth, industrial explosives are playing an important part in the construction of diversion tunnels and spillways, and in establishing foundations.

Under a joint-venture contract, awarded by the U. S. Army Corps of Engineers, Macco Corporation of Paramount, California, and Morrison-Knudsen Company of Boise, Idaho, are doing the construction work. The excavation items on the main dam outlet works, including a tunnel 17 ft. in diameter and 850 ft. long, have been completed by Walsh Construction Company of San Francisco.

A review of the construction activities on this multiple-purpose project will be found on page 186.

• • •

Erratum in September-October, 1952, issue: In presenting the article entitled "Relocating a Mountain Highway in North Carolina," it was stated in the paragraph at the top of page 162 that "detonation was accomplished by means of a conventional blasting machine." This should have read: "detonation was accomplished by means of a special condenser-type blasting machine."

We regret that the above inaccuracy was not detected before the article was printed.

*Reg. U. S. Pat. Off.

EDITORIAL STAFF: JOSEPH I. HORTY, *Managing Editor;* ELIZABETH M. JOYCE, *Assistant Editor;* GERTRUDE A. DONNELLY, *Assistant Editor;* EDWARD L. GRANT, *Art Editor;* FRANK J. CANOVA, *Production Manager;* CHARLES E. RABENOLD, *Advertising Manager;* THEODORE MARVIN, *Director;* MONTGOMERY R. BUDD, *Associate Director.*

SUBSCRIPTION RATES: *United States and Canada*—One Year, $1.50; Single Copies, $.30. *Limited Subscriptions Only to Other Countries*—One Year, $2.50; Single Copies, $.50.

THE EXPLOSIVES ENGINEER, 913 DELAWARE TRUST BUILDING, WILMINGTON, DELAWARE. PRINTED IN UNITED STATES OF AMERICA.
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VOL. 30 NO. 6 NOVEMBER-DECEMBER, 1952 CEA

PROGRESS IN EXPLOSIVES . . .

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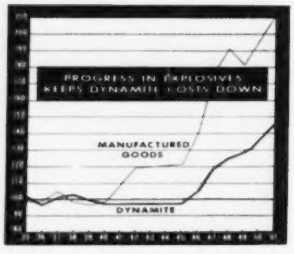

Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods.1935-39values=100.

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THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS

Arthur V. Wiebel

PRESIDENT, TENNESSEE COAL & IRON DIVISION

UNITED STATES STEEL COMPANY

A Biography

ARTHUR V. WIEBEL, president of Tennessee Coal & Iron Division of United States Steel Company, a successful and notably progressive steel and mining executive, is known and admired not only for his technical and administrative accomplishments, but also for his wise understanding of human relationships.

"Art," as he is known to his friends, was born March 26, 1907, in Cumberland, Allegany County, Maryland, the son of Vance and Louise (Snyder) Wiebel. His early schooling was at Cumberland's West Side Grammar, Union Street Junior High, and at Allegany County High, where he completed the third year. At the end of his junior high-school year, he moved with his family to Pittsburgh, Pennsylvania, and finished high school at Schenley High in June, 1924.

The following September he enrolled in Carnegie Institute of Technology and was graduated four years later, second in his class, with a B.S. degree in mechanical engineering. He was awarded scholarships for his sophomore through senior years, and was elected to membership in the Nu Chapter of Theta Tau, the professional engineering fraternity. He worked his way through college. In his sophomore year, he was made a teacher of mathematics at Carnegie Tech's night school. He continued in this teaching assignment throughout his undergraduate days and for three years after. During postgraduate years, he took courses in advanced mathematics, mechanics, and physics.

On June 1, 1928, he went to work for Koppers Construction Company in Pittsburgh, as designer, squad boss, and engineering secretary. Three years later, he was transferred to Kearny, New Jersey, as operating engineer for Koppers Seaboard Coke Company, continuing in that position until May, 1932. He returned to Carnegie Tech for the school year 1932-1933, to resume the teaching of mathematics.

In July, 1933, Art began his association with United States Steel Corporation as an estimator in the engineering department of Carnegie-Illinois Steel Corporation, Youngstown, Ohio. Four years later, he was promoted to the job of special engineer for Carnegie-Illinois Pittsburgh district. After a year of this work, he was assigned to Homestead, Pennsylvania, to become assistant chief engineer of the corporation's Homestead Works.

On March 1, 1940, he was called back to Pittsburgh to take over the duties of chief engineer for the Pittsburgh district. He remained in that position until December, 1940, when he was appointed assistant to the vice president in charge of engineering and operations of United States Steel Corporation of Delaware.

Soon after Pearl Harbor, Art was made executive consultant to the director of the steel division of the War Production Board in Washington. He continued in that capacity until the end of 1942.

On October 1, 1946, he was transferred to the executive offices of Tennessee Coal, Iron and Railroad Company in Birmingham, Alabama. Three months later, he was elected to the position of vice president, in charge of TCI's operations. He served in that capacity until January 1, 1951, when he was elected to the presidency of the company, which position he holds today. As of January 1, 1952, the company's name was changed to Tennessee Coal & Iron Division, United States Steel Company.

Mr. Wiebel is a director of Southern States Industrial Council; Jefferson County, Alabama, Coordinating Council of Social Forces; Alabama State Chamber of Commerce; American Red Cross of Birmingham; Birmingham Community Chest; and Birmingham Chamber of Commerce. He is a trustee of Southern Association of Science & Industry, Inc., and of Southern Research Institute. He is a member of the Civil Defense Council of the State of Alabama; the Advisory Board, Birmingham Ordnance District, and the Army Ordnance Association.

Other affiliations include memberships in American Iron and Steel Institute, New York; British Iron and Steel Institute, London; Association of Iron and Steel Engineers, Pittsburgh; and Newcomen Society, Philadelphia. His clubs are the Duquesne in Pittsburgh; the Downtown, Rotary, Mountain Brook, Birmingham Country, Vestavia Country, and the Men's Club of Independent Presbyterian Church, all in the city of Birmingham.

Arthur V. Wiebel married Anna Ruth McClelland on May 19, 1934, in Wilkinsburg, Pennsylvania. They have one child, Gretchen Ann Wiebel, age thirteen. The family home is at 2617 Heathermoor Road, in Birmingham.

Art will travel almost any distance for alleged good fishing, when time and opportunity permit. He's a born fixer—likes to work with his hands on mechanical and electrical gadgets. His neighbors have discovered, to their profit, that he's something of a wizard with balky automobile and power lawn mower engines. He enjoys an occasional game of golf with friends, but he adds with a broad smile, "I'm not old enough to become serious about it."

ARTHUR V. WIEBEL

Editorial

★ Merry Christmas—Happy New Year ★

The members of the editorial staff of THE EXPLOSIVES ENGINEER extend holiday greetings to our readers with the sincere wish that you have a very Merry Christmas and a Happy New Year.

Look Before You Buy

Every working day, industrial explosives are used in many mines, quarries, and on construction projects. The cost of the explosives used is relatively small in relation to the tons of ore, coal, or rock blasted. But the fact that their use is continuous, that many other cost items depend on the results obtained from explosives, makes it important that the buying of explosives be done with deliberation and care.

In recent years, improved types and grades of dynamite and blasting supplies have been introduced to industry. Every operator should investigate the opportunities for effecting economies, which have been made possible by intensive research and exhaustive tests in the field. Explosives manufacturers have available trained representatives to help in analyzing your drilling and blasting procedures, and in selecting and applying the explosives best suited to your operations. You will find it worthwhile to consult with them.

"Don'ts" For Explosives Users

The increased demand for diversified products, brought about by the war in Korea and our national defense program, has necessitated the employment of many inexperienced workers in the mining, quarrying, contracting, and other industries in which dynamite and blasting supplies are primary instruments of production. In addition to these individuals who are called upon to handle, store, and use explosives for the first time, there are many individuals who have become amateur prospectors and, with little or no experience, are learning to use dynamite and blasting accessories to open up discoveries of strategic minerals.

For the benefit of these beginners, we present on page 191 of this issue a list of instructions and rules entitled "Don'ts," as prepared by the Institute of Makers of Explosives. These instructions and rules are also printed on a leaflet which is packed inside every case of dynamite shipped from explosives manufacturers.

A careful study of this code of regulations should be the responsibility of everyone using explosives. The beginner will find the concisely written instructions of invaluable aid in acquainting him with the methods of storing, transporting, and using high explosives and permissible explosives. These methods have been determined by the foremost explosives engineers to be the safest and most effective. Also outlined are the elements of correct priming, loading, tamping, and firing.

The importance of the list of "Don'ts" for users of industrial explosives, either beginners or oldtimers, cannot be emphasized too strongly.

Competition Stimulates Interest

Every well-planned, well-directed campaign to prevent accidents in mines and quarries results in benefits that outweigh the cost in money and effort. These benefits are shared by all concerned—labor, management, and stockholders. Such campaigns are successful only when management is firmly committed to support them. The motives that inspire safety work are not important. The well-being and productiveness of workmen, the efficiency of management, and the profits of stockholders will be increased with equal certainty whether plans for accident prevention are based on the desire for greater gain, or on the highest ideals of humanity.

Entering the National Safety Competition has proved helpful in stimulating interest in safety among the workmen in many mines and quarries. It represents organized safety at its best. We urge you to enter your plant in this contest. For rules and complete information about this nation-wide competition, address your communication to the Chief of the Accident Analysis Branch, Health and Safety Division, Bureau of Mines, U. S. Department of the Interior, Washington 25, D. C.

A 30-Year Record

The annual report of the chief inspector of the Bureau of Explosives, Association of American Railroads, includes the announcement that during 1951 there were no deaths or injuries chargeable to the rail transportation of explosives. This performance record has been maintained for 30 consecutive years. Last year's record was achieved during a period of a new all-time high in the production of explosives in the United States.

This Bureau, organized in 1907, with the support of railroad companies and manufacturers who are associate members, has become one of the most effective safety-promotion agencies in the country. It has made and is making a daily contribution to safety and welfare throughout the nation.

Credit is also reflected upon the ingenuity with which explosives manufacturers have processed, packaged, loaded, and braced their products in railroad cars for shipment. But the American people are grateful, primarily, to the railroads' Bureau of Explosives for protecting their lives and property.

SUBMARINE BLASTING: The material used in the construction of Levees L-33 and L-37 must come from borrow pits. It must be blasted or otherwise reduced in size to particles of less than 2 ft. in diameter. The 2-ft. sizes of rock must be kept to a minimum. Blasts in the submerged limestone consisted of 10 to 14 rows of drill holes spaced on 9-ft. centers with the rows 8 ft. apart. The holes were loaded with 40% Gelatin Extra dynamite on a ratio of 0.54 lbs. of explosives per 1 cu. yd. of burden in place.

Levee Construction Through Florida's Everglades

The completion of an interrelated system of water control will benefit an area of 2,300,000 acres of land south of Lake Okeechobee

CHARLES R. SPARF*

THE Jacksonville District of the U. S. Army Engineers awarded a contract on March 6, 1951, to Hooper Construction Company of Coral Gables, Florida, in the amount of $1,270,862, for the construction of Levees L-33 and L-37, part of the Central and Southern Florida Flood Control Project. These levees, located 10 miles north of Hialeah, Florida, extend for a distance of 14.7 miles and are approximately parallel to U. S. Highway 27 from the Miami Canal to just north of the junction of that highway and U. S. Highway 84. The Hooper Company's operating crews are thoroughly familiar with this type of construction, having previously completed two similar units on the project—Levees L-35A and L-36—and a test levee north of Tamiami Canal.

*Hercules Powder Company
Birmingham 5, Alabama

The Central and Southern Flood Control Project was designed by the Army Engineers primarily to provide protection against damages that accompany recurring floods and droughts. The plans call for an interrelated, comprehensive system of water control for the benefit of an area of about 2,300,000 acres south of Lake Okeechobee. In addition to its flood-control features, the overall project includes an integral system of levees, spillways, canals, and basic structures designed to remove flood waters rapidly and to form two large water reservoirs. Also, it will afford protection to the developed acreage in the area from damages caused by poor drainage or salt water infiltration. With the completion of the levees now in progress of construction, plus those which have been built, there will be a continuous line of levees from Lake Okeechobee to the Tamiami Canal. Estimates of the time required to finish this program vary from five to ten years, and the total costs are estimated to be in excess of $210,000,000.

Annual Flood Damages Approximate $11,500,000

From studies of the damages resulting from the 1947 flood and the frequency of damages from flood waters in the whole area, the annual damage

A COMPLETED SECTION: The levee embankment consists of fossiliferous limestone which is blasted and recovered under water in the borrow pit at the extreme right. The average width of a borrow pit on the Hooper Construction Company's contract is 75 ft. The crown of the levee is 10 ft. wide, the cross side slopes are one on three, the base is 80 ft. wide, and the height averages 12 ft. MSL.

expectancy is estimated at approximately $11,500,000. It is hoped that the completion of the project will reduce this annual damage figure by approximately 75 per cent. The frequency of floods is anticipated as one every 25 years in the lower east coast and one every six to ten years in other parts of the area.

Most of the funds for construction of the Central and Southern Florida Flood Control Project will come from the Federal Government, as enacted by the Congress in the Flood Control Act of June 30, 1948. Local interests are required to provide all land easements and rights-of-way and to make cash contributions of 15 per cent of the estimated cost of the work completed on each part of the project.

The construction of Levees L-33 and L-37 requires approximately 1,900,000 cu. yds. of material in the embankments. The crown of a levee is 10 ft. wide, the cross side slopes are one on three, the base is 80 ft. wide, and the height averages 12 ft. MSL. Surface vegetation, including roots, must be cleared and stripped from the base of the levee and from the surface of the borrow pit. The material removed in clearing and stripping is wasted on the pool side of the levee, or on the land side of the borrow pit. The minimum width of the borrow pit is 60 ft. (the average on the L-33 and L-37 contract is approximately 75 ft.). The material used to build the levee must come from the borrow pit and must be blasted or

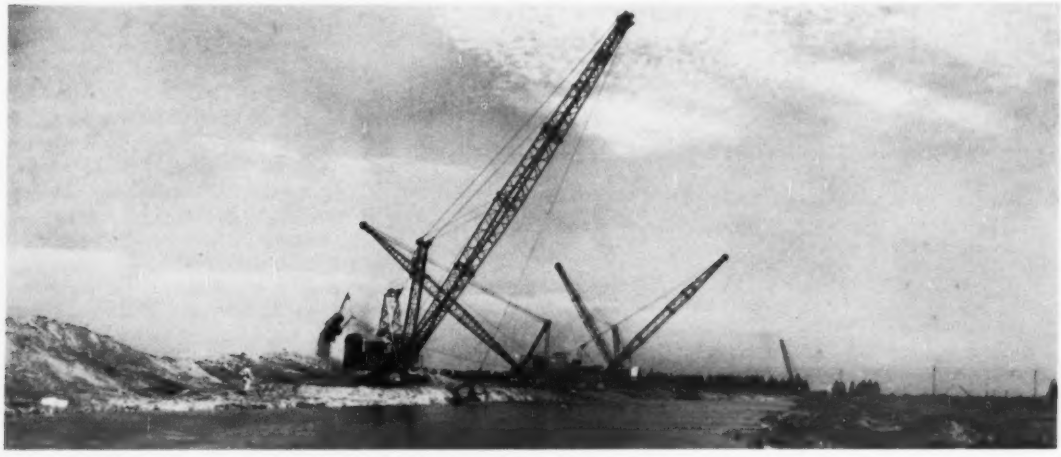
BLASTING PREPARATIONS: Holes for blasting the limestone under water in the borrow pits were drilled with Gardner-Denver drifters mounted on heavy scat backs, which were attached to 20-ft. leads connected to Oliver Cletracks. The dynamite charges were loaded into the drill holes through pipes, each with an internal diameter of 1½ in.

otherwise reduced in size to particles of less that 2 ft. The larger rock, approaching the maximum diameter of 2 ft., must be kept to a minimum.

Rapidly Changing Rock and Muck Formations

The rock formation on the L-33 and L-37 contract is referred to locally as Florida Oolite. Geologically, it is a fossiliferous limestone of variable age with some massive displacement of the lime with silica. It varies in hardness and thickness with extreme rapidity. It occurs in varying layers and is very porous, with many voids. It ranges from loosely cemented large- and small-sized shells to very fine and com-

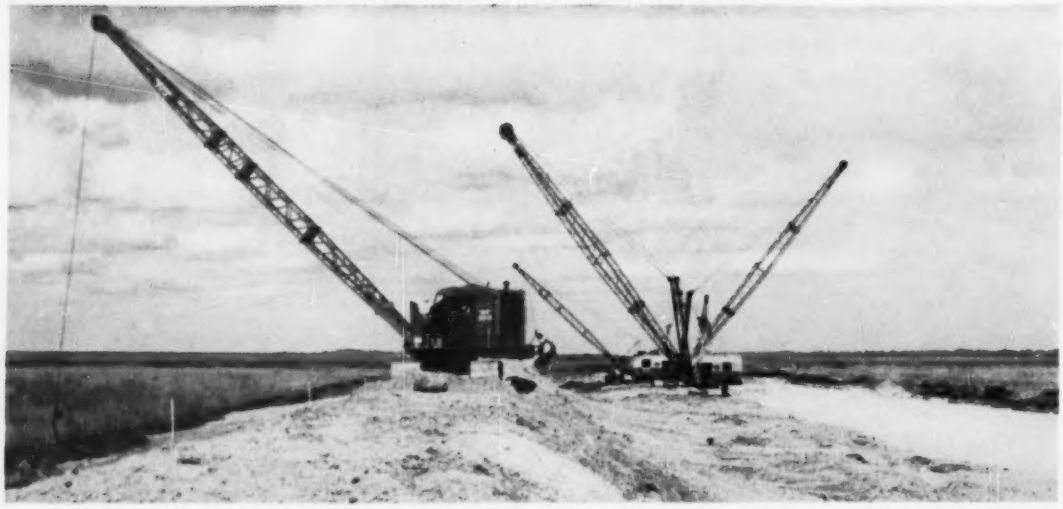
AFTER A BLAST: A close-up of one of the draglines excavating blasted limestone from a borrow pit for deposit on the embankment. The draglines are operated from heavy mats because of the swampy nature of the area.



MULTIPLE DRAGLINE OPERATION: A battery of five draglines — two Bucyrus-Eries, two Limas, and one Link-Belt — at work recovering blasted material under water at the bottom of the pit and dumping it onto the levee at left center.

pactly cemented rock. The thickness of the rock layers varies from less than 1 ft. to 10 ft. The material between the layers ranges from muck to marl to fine sand—sometimes in combinations of these materials. The rapidity of change in the thickness and hardness of the rock layers, plus the flexibility of the rock itself, caused the blasting to be a matter of extreme importance.

The levees are being constructed through the Everglades, a section of the State that is covered with sawgrass and a variety of other swampy vegetation growing out of extremely heavy muck. The muck varies in thickness from a very thin layer to pockets 20 ft. deep. Its composition is so carbonaceous that it will burn on the order of peat in the dry seasons. The water table varies from just below the surface of the ground in the dry seasons to several feet above the ground in the rainy months. Because of the swampy nature of this area, several innovations were introduced in the structure and operation of the equipment used. Most of the time draglines had to be operated from mats and drilling equipment was designed especially for this type of terrain. Gardner-Denver Model 95 drifters were mounted on heavy seat backs, which were attached to 20-ft. leads connected to Oliver Cletracks. This arrangement made it possible to move and to operate the drills



"DRESSING UP": One dragline operator was assigned to "dressing up" operations on the levee embankment in the wake of the larger dragline units employed in excavating procedures on the L-33 and L-37 contract.

FRED W. HOOPER: The boss observes job progress from one of his company's air boats. Made of aluminum, with flat bottoms, the boats are powered by airplane engines with propellers mounted on the rear. A vertical fin provides steering facilities. Their maneuverability makes them ideal carriers of materials in wet, mucky terrain.

in the wet, mucky ground. The drills were fed by gravity and were raised by means of small G-D air hoists with a cable arrangement. The drills were equipped with Gardner-Denver 1-in. round steel and Timken 1¾-in. detachable bits. Air to power the drills was supplied by three portable Diesel compressors, two 500-c.f.m. Gardner-Denvers and one 600-c.f.m. Ingersoll-Rand. The compressors were mounted on Athey wagons fitted with wooden mud cleats. Five of these self-propelled drilling units were used on the Hooper job. They were divided into two drilling sections: one section included three drills with the air supplied by the two G-D 500-c.f.m. compressors connected in series; the second section included two drills and the necessary air was furnished by the I-R 600-c.f.m. compressor. This two-group method provided more freedom of movement for the drilling operations.

Because of the type of the material in the area and the fact that most of it was under water, the loading of charges of explosives into drill holes had to be done through a pipe. This loading pipe, with an internal diameter of 1½ in., was designed so that it could be used for blowing out drill holes as well as for loading the explosives without removing the pipe after the blowing out operation.

The dynamite selected for blasting was Hercules* 40% Gelatin Extra in 1¼ by 8-in. cartridges. This type of powder was chosen because its water-resistant characteristics make it especially adaptable for use in holes filled with water. Also, its rate of detonation, when confined, makes it desirable when blasting porous and unsolid material.

Primary Blasting

An interesting variation of the usual method of primary blasting in this type of Florida rock was introduced on the Hooper job. The dynamite charges in the holes in the center of the borrow pit longitudinally were detonated first by the employment of Hercules* Electric Blasting Caps, and the holes on both sides of the center section were detonated with Hercules No. 3 No Vent* Short-Period Delay

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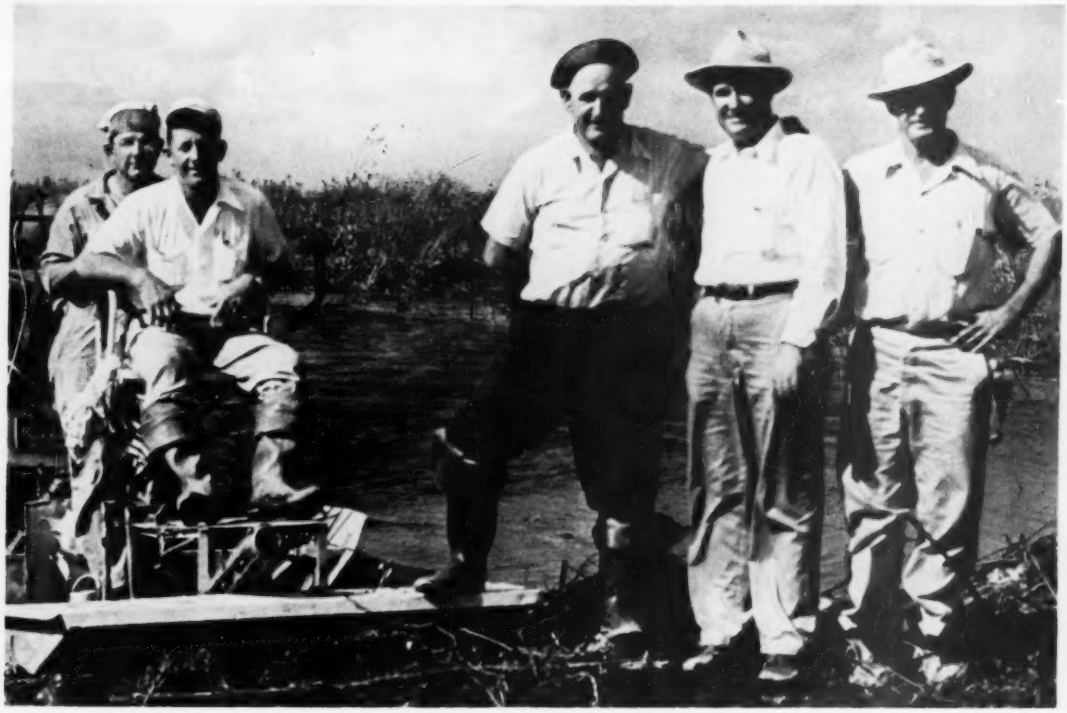


LEFT TO RIGHT: Ernest Smith, chief mechanic, and Luther Frye, drilling and blasting foreman, Hooper Construction Company; Denis V. Plan, Hercules Powder Company; Milan Hooper, line superintendent, and Lamar Smith, superintendent, Hooper Construction Company.

Electric Blasting Caps. This method of blasting produced a cut down the center and, after a delay of a millisecond, broke the rock on both sides of the center cut. This resulted in much smaller breakage than heretofore experienced. As the thickness and the hardness of the rock varied, the drilling pattern and the explosives-loading factor were changed to fit existing conditions. Because most of the blasting was done under water, the leg wires of the caps were connected in series parallel to No. 8 single-strand reusable copper wires, which were strung along the side of the blasting area in the dry. Not more than 20 electric blasting caps were connected in a series. From 100 to 150 holes were fired in each blast, with a blasting machine.

The excavating equipment included two 1201 Limas, two 54B Bucyrus-Eries, and one 585 Link-Belt. All of these units were employed as draglines. A Model 22 Bucyrus-Erie was used to trim the levees. Two small draglines, a Koehring and a Link-Belt, took care of the stripping operations.

Caterpillar tractors, ranging from a D-8 to a D-4, fitted with wooden mud cleats, were used to haul supplies and move the compressors.

As work on the Hooper contract progressed, the area became wetter and muckier, and air boats were employed to expedite the movement of supplies. These air boats are made of aluminum and have flat bottoms. Airplane engines are used for power and the propellers are mounted at the rear of the boat. A vertical fin gives them steering ability. They are able to move through the Everglades with a full load at a good rate of speed.

Huge Conservation Pools

As indicated previously, Levees L-33 and L-37 are being built as an integral part of the Central and Southern Florida Flood Control Project to bring greatly needed benefits to the area south of Lake Okeechobee. One of the features of the Army Engineers' program that highlights the scope of the overall project is that three huge conservation pools encompassing 1,500 sq. mi. will be provided by means of the encircling levees. At their maximum, these three pools will store approximately 4,500,000 acre-feet of water, and one pool will be larger in area than Lake Okeechobee. At present, the economic growth of Florida is so rapid that the benefits to be derived from the project can only be estimated.

All activities on the L-33 and L-37 levee contract are under the direction of Colonel R. W. Pearson, district engineer, Jacksonville district, U. S. Army Corps of Engineers. He is assisted by Robert Broadfoot, area engineer, and Charles Miller, project engineer. The details of construction on this job are under the personal supervision of Fred W. Hooper, president of the contracting company that bears his name, with Lamar C. Smith, superintendent; Milan Hooper, line superintendent; and Luther Frye, foreman of the drilling and blasting operations.

IN THE PIT: The coal seams in the 100-ft.-wide pits are prepared for recovery by a power shovel by blasting with charges of pellet powder on a 6 by 6-ft. staggered drill-spacing pattern.

Marriott-Reed Coal Company

Operations near Columbia, Missouri, include drilling, blasting, and excavating banks of overburden 38 ft. high to recover 28 in. of coal in the Bevier seam

J. R. McCLOSKEY*

The names of Marriott and Reed have been prominently identified with the coal industry in Missouri for many years—the Marriotts in the shaft-mining field near Moberly, and the Reeds in strip mines in Calloway County. Members of the two families formed a company in 1936, called Marriott-Reed Coal Company, to strip-mine coal in the Bevier seam and build a preparation plant at a location about 11 miles east of Columbia, Missouri, adjacent to U. S. Highway 40. A fire destroyed the plant in the late fall of 1949 and a new, modern preparation plant was erected and put into operation in May, 1950. The capacity of the new plant is in excess of 1,000 tons of high-quality coal a day.

In the early years of World War II, the shortage of metals and a limited water supply on the Marriott-Reed property were responsible for the development of a water-treating system to neutralize the high acidity in the mine water. Jim Linn, the company's mine superintendent and chief developer of the system, sums up in a few words the serious problem that confronted the company at the time: "The 'hot' water would eat out a pump every two weeks, but we could get a new pump only every six months, because of material shortages."

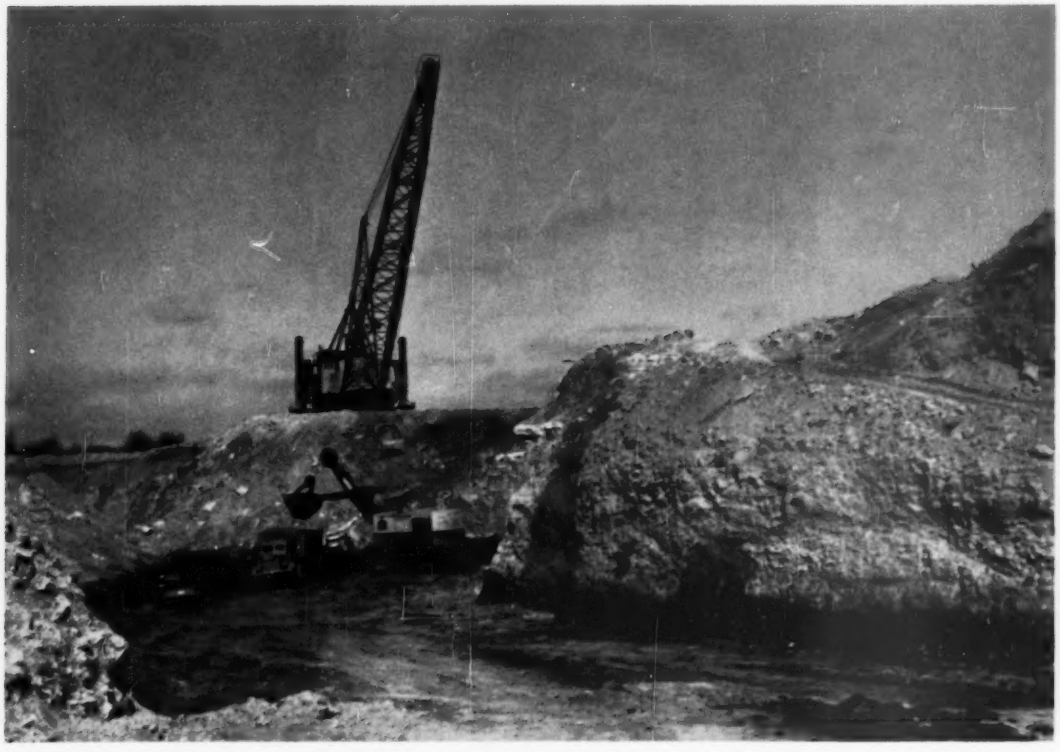
*Hercules Powder Company
Chicago 4, Illinois

Unique System for Treating Mine Water

Available water is from natural drainage into artificial ponds located near the tipple. Sludge water from the tipple flows into a settling pond, the sludge is dropped, and excess water drains back into the supply ponds. Through the years, the water in the supply ponds became extremely acid and the amount of "new" water available was not sufficient to overcome the high acidity. A deep well was sunk but the additional water from it was not adequate to provide the remedy.

After much thought and many experiments, a system of automatic and continuous water treatment was developed. It involves the introduction of lime or soda ash into the water entering the washing system. At first, the amount of the neutralizing agent used was excessively high in order to overcome the high acid content of the supply ponds. Now that water in the

PREPARING THE OVERBURDEN: A truck-mounted Permanco unit is used to drill horizontal holes into the overburden in preparation for blasting with Hercomite 2 dynamite in 3½ by 16-in. cartridges.



TWO-WAY OPERATION: While a No. 625 Page 7-cu. yd. dragline is stripping a bank of overburden, a 2-cu. yd. Model 362 Marion power shovel is recovering the coal in the 100-ft.-wide pit.

LEFT TO RIGHT: Company operations and sales are supervised and directed by Jim Linn, mine superintendent; V. E. Reed, vice president; W. E. Marriott, secretary and sales manager.

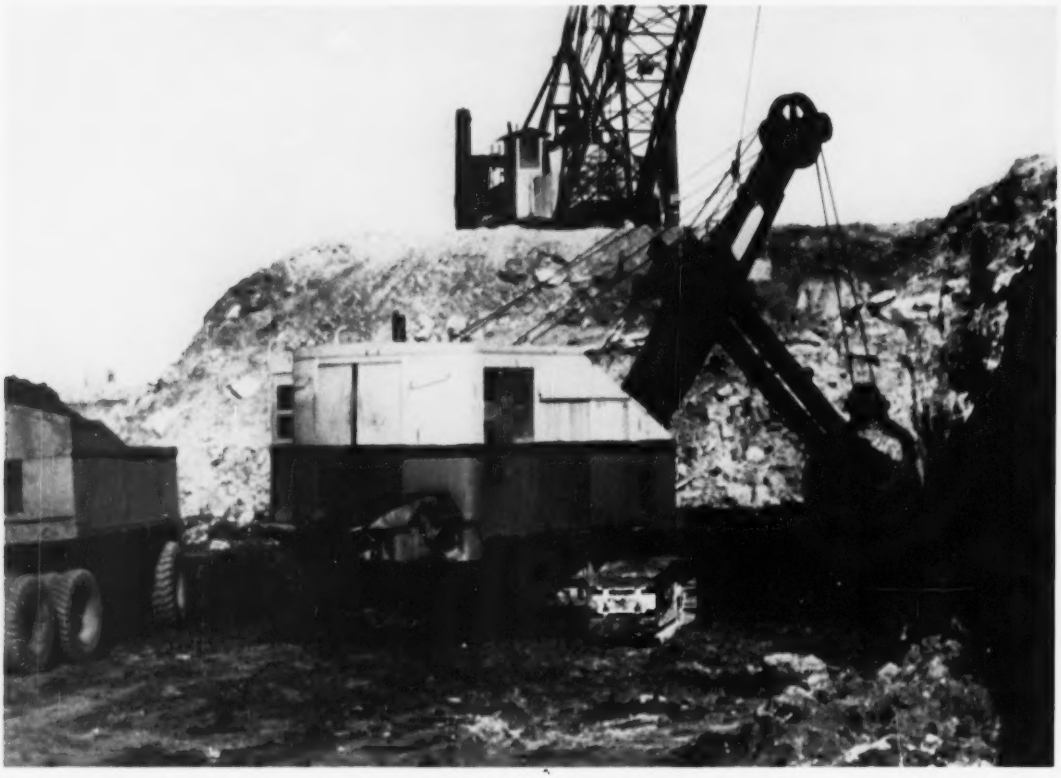
ponds has been neutralized, only a small amount of lime or soda ash is required to balance the system.

The need for a process of this kind has been expanded because of the new closed system in preparation plants, the developing pollution problems in some areas, the need for water conservation, and the elimination of damages to equipment. The process has been patented by Superintendent Linn and is being introduced to the trade by Water Neutralizing Company of Columbia, Missouri.

The Bevier seam of coal in Boone and Calloway Counties, Missouri, in which Marriott-Reed Company operates, is of Pennsylvania age. Company crews are strip-mining it on the southwest slope of the anticline that dominates the coal geology in the area. The anticline has a northwest-southeast axis that crosses the mine property. The coal has been eroded in extremely low areas and near the apex of the anticline. Crop-line coal occurs well up on the rather gentle hills. The coal seam, averaging 28 in. in thickness, dips slightly to the southwest.

Stripping the Overburden

The overburden on top of the seam averages 38 ft. A gray shale of 10 to 12 ft. lies directly over the coal. On top of the shale is a formation of soft sandstone 10 to 15 ft. deep. Above the sandstone is a ledge of limerock about 5 ft. thick. The balance of the overburden is clay soil. In some parts of the mine area the overburden consists entirely of a soft limestone. Stripping in these parts is restricted to the summer months.



RECOVERING THE COAL: A close-up of the 2-cu. yd. Model 362 Marion power shovel at work in a pit recovering the 28-in.-thick seam of coal and loading it into a 30-ton Dart truck for delivery to the preparation plant.

PREPARATION PLANT: This modern preparation plant was built by McNally-Pittsburg in May, 1950, following the destruction of the original plant by fire. Present plant capacity is in excess of 1,000 tons of high-quality coal a day.

The stripping program calls for the maintenance of two pits, each 100 ft. wide, at all times. One pit is stripped with a #625 Page 7-cu. yd. dragline; the other pit with a #621 Page 5-cu. yd. dragline. A truck-mounted Permanco horizontal drill is employed to prepare the banks of overburden in both pits. The drilling pattern is dominated by a rib hole, 4½ in. in diameter, which is collared about 8 ft. above the coal and drilled to a depth of 70 ft. The hole is angled upward to bottom as high as possible against the top limerock formation. Additional holes, following the same pattern as the rib hole, are drilled on 20- to 30-ft. centers across the face of the pit, the spacings being governed by existing conditions. Hercomite* 2 dynamite in 3½ by 16-in. cartridges is loaded in a solid column in the drill holes, and blasts are detonated by electric blasting caps. The 70-ft. depth of the drilling and blasting pattern provides two cuts for the operation of the two Page draglines.

*Reg. U. S. Pat. Off.

"Red Flame" Coal

After the overburden has been blasted and excavated, the coal is prepared for extraction by blasting with charges of pellet powder fired by safety fuse on a 6 by 6-ft. staggered spacing pattern. The fractured coal is recovered by means of a 2-cu. yd Marion 362 power shovel and loaded into 30-ton Dart trucks for delivery to the preparation plant. After it is treated in the plant, the prepared coal, known as Red Flame, is loaded into trucks for distribution to industry and homes located in a wide area of Missouri.

A large shop in the tipple area provides maintenance facilities for haulage equipment and similar major repair work. A field welding shop takes care of repairs to dragline buckets, shovel dippers, and other equipment units in the pits.

JIM LINN'S INVENTION: The Wanuco system provides for an automatic and continuous water-treating process for neutralizing the acidity in mine water. The unit and the process were invented and patented by the company's mine superintendent.

LEFT TO RIGHT: James Westfield, chief, Health and Accident Division, U. S. Bureau of Mines; I. N. Bayless, president, The Union Pacific Coal Company; Theodore Marvin, director, The Explosives Engineer; Lawrence Welsh, superintendent, and Milton Friel, duckbill operator, Reliance No. 7 mine, The Union Pacific Coal Company.

UNION PACIFIC'S COAL MINERS WIN TOP SAFETY HONORS FOURTH CONSECUTIVE YEAR

Reliance No. 7 miners worked 1,684,394 man-hours underground in Wyoming without a lost-time injury from 1948 to 1951 inclusive

OLD TIMERS' BUILDING in Rock Springs, Wyoming, was the scene of a gala dinner-ceremony on October 26, 1952, when officials of The Union Pacific Coal Company were hosts to 550 employes of its Reliance No. 7 mine, their wives and guests, to celebrate the award of the Sentinels of Safety trophy to the Reliance miners for their victory in the 1951 National Safety Competition. The record of the Reliance miners last year—464,666 man-hours of work without a lost-time injury—won for them the coveted trophy for the fourth consecutive year.

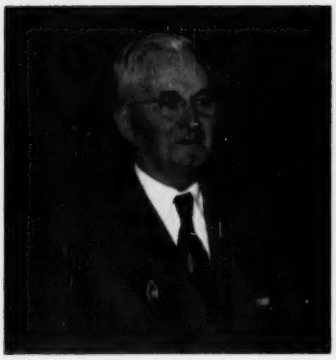
Following the invocation by the Reverend William Delaney, and the enjoyment of a delicious dinner prepared and served by the ladies of St. Monica's Sodality, the ceremonies began with a brief address by the toastmaster, Vernon O. Murray, vice president of the coal company's operations. After extending congratulations to the men of Reliance No. 7 mine for their splendid accomplishments in safety on the job for four straight years, Mr. Murray introduced E. S. Hamilton, general superintendent of Norfolk & Western Railway Company's coal mines in Kentucky, as the guest speaker.

Miners Directly Responsible for Safety Records

In paying tribute to the Reliance miners for their remarkable consistency in winning safety honors, Mr. Hamilton said that "any group of miners who can accomplish what you did in 1951, and for the three years immediately preceding last year, is deserving of the highest praise that words can express. You men at Reliance No. 7 mine are directly responsible for the winning safety records at your property. I hope you keep up the good work, not only to win rewards for yourselves and your company, but as a means of setting an example of what can be done in accomplishing safe working conditions in coal-mining operations everywhere."

Continuing, Mr. Hamilton told the miners, "We have three mines in Kentucky with perfect safety records for the first eight months of this year. We're breathing down your necks, men. I'm letting you in on this news because we are keeping everlastingly at the business of accident prevention in our mines. Some day, we're going to receive word from THE EXPLOSIVES ENGINEER that the Sentinels of Safety trophy is being forwarded to one of our winning mines."

In his concluding remarks, Mr. Hamilton said that he wanted to pay special tribute "to the women who are with us tonight, particularly the wives of the miners. You are equally responsible with the men for the remarkable safety records that have been made in Union Pacific's coal mines. We salute and thank you for your wholehearted cooperation."



TEAM SPIRIT PREVAILS: In commenting on the accomplishments of his organization, I. N. Bayless, president of the coal company, stated that "in our operations, safety embraces every employe, up to and including the president himself."

MINERS' REPRESENTATIVE: As the representative of the Reliance No. 7 miners, Milton Friel, duckbill operator, accepted the trophy "as an emblem of the cooperative effort of employer and employe at all times and in all places."

"WE'LL DO IT AGAIN": After accepting the individual certificates on behalf of his fellow workmen, Lawrence Welsh, Reliance No. 7's superintendent said, "We're proud of what we have done in the past and we're aiming at doing it again."

"KENTUCKY SALUTES YOU": In congratulating the Reliance miners, E. S. Hamilton, general superintendent of the N. & W. Railway Company's coal mines in Kentucky said, "You men surely rate the highest praise that words can express."

Organization Is the Key

After introducing some of the guests present, the toastmaster called upon Theodore Marvin, director of THE EXPLOSIVES ENGINEER, to make the awards of the Sentinels of Safety trophy and flag to the Reliance No. 7 mine. Mr. Marvin cited organization as the answer to the outstanding safety records made by The Union Pacific Coal Company in winning 13 of the 27 Sentinels of Safety trophies in the bituminous-coal mine classification. "As most of you know," he said, "we recently devoted an entire issue of THE EXPLOSIVES ENGINEER (May-June, 1952) to a description of Union Pacific coal properties and their operations, with particular emphasis on the development of their safety programs. I want to quote from an editorial which prefaced that article. 'The only miracle at Union Pacific Coal is the miracle of organization. The will and ability to master natural coal-mining difficulties —to overcome more-than-usual hazards —stem from a deep-seated understanding of each miner, fortified with an intense desire to make the individual

(Continued on page 193)

ORGANIZATION IS THE KEY: Theodore Marvin, director of The Explosives Engineer, cited organization as the answer to Union Pacific's winning 13 of the 27 Sentinels of Safety trophies awarded to date in the bituminous-coal mine group.

INDIVIDUAL REWARDS: Subsequent to awarding individual certificates to the winning miners, James Westfield, chief, Health and Accident Division, U. S. Bureau of Mines, commended the miners for their outstanding achievement in winning top safety honors in this nation-wide contest four years in a row.

A LOGICAL CONCLUSION: Lyman Fearn, state coal mine inspector for Wyoming, said, "With the best mines and the best miners in the country, it is logical that you men should make the best records."

THE ISABELLA DAM
IN CALIFORNIA'S KERN VALLEY

The completion of a $21,710,000 multiple-purpose structure below the junction of two forks of the Kern River will bring benefits to a large area

PAT and GEORGE STURTEVANT*

CALIFORNIA'S historic Kern Valley is the locale of a $21,710,000 combination flood control, conservation, and recreation dam project, designated Isabella Dam. The construction of this multiple-purpose dam made necessary the inundation of two colorful old communities, Isabella and Kernville. However, the inundation of the two towns (they are being relocated near their original boundaries) will be compensated by putting a harness on the rampaging Kern River, whose rushing flood waters two years ago caused multimillion-dollar damage in the rich lower San Joaquin Valley near Bakersfield. The job designed for the dam to do will have an important bearing upon the future economy of a large section of the State of California.

*Box 1132
Trona, California

The site of Isabella Dam is a rolling valley immediately south of the junction of the north and south forks of the Kern River, about 150 miles north of Los Angeles. It is a two-structure project divided by a rocky hill upon which the operations and administration buildings are located. Although the dam is being built primarily of earth, modern explosives are playing an important part in the construction of diversion tunnels and spillways, and in the establishing of foundations.

Under the direction of the U. S. Army Corps of Engineers a number of major and minor contractors have been and still are busy on the many-

THE OUTLET PORTAL: A view of the outlet portal of the main dam outlet works, as seen from the west side of the river.

phased project. The construction of the dam, which includes the moving of an entire hill for fill, is being done by Macco Corporation (sponsor) of Paramount, California, and Morrison-Knudsen Company, Inc., of Boise, Idaho, under a joint-venture contract.

Contract Specifications

The principal items in the several contracts consist of the construction of a main dam, an auxiliary dam, an outlet tunnel, a control tower and a spillway, and the relocation of a canal, electric power distribution lines, private and forest service telephone lines, two highways, and the towns of Kernville and Isabella.

The main dam is designed to be 1,725 ft. long, with a maximum height of 185 ft. The estimated volume of excavation is 540,000 cu. yds. Upon completion, the finished dam will have an earth-fill embankment comprising 2,900,000 cu. yds. of material. The auxiliary dam, largely completed, is longer but lower, having a length of 3,325 ft. and a maximum height of 100 ft. The excavation for this unit totaled 150,000 cu. yds. and its earth-filled embankment has a volume of 1,800,000 cu. yds.

At the time of the writers' visits (August, 1952), the main dam outlet works had been completed. The excavation on that part of the job was done by Walsh Construction Company of San Francisco, with H. C. Smith Company of Los Angeles doing the concrete work. Numerous other subcontractors performed specialized tasks related to the overall project.

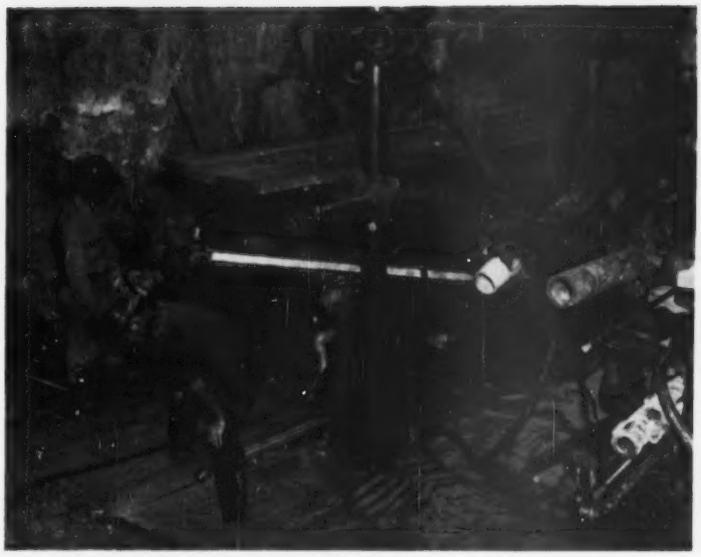
The outlet tunnel is an 850-ft. bore driven through fractured granite by the Walsh Company. After rough excavation, the diameter of the bore was 17 ft. This was reduced to 14 ft. 9 in. when lined with pumpcrete by the Smith Company.

The spillway, 140 ft. wide at the crest, is designed to permit the automatic release of excess flood waters from the reservoir. It was drilled and blasted out of granite in the west shoulder of a hill that separates the main dam from the auxiliary dam.

The portion of the overall contract performed by the Walsh and Smith companies for the Army Engineers amounted to $959,889. This figure included grouting, installation of slide gates and operating machinery, hoist and electrical systems, lining of the tunnel, construction and lining of the valve chamber, construction of the control tower, and the hauling and storing of slide gates for the relocated Southern California Edison Company's Borel canal.

The remainder of the work on the project consists of relocating existing telephone and power lines and highways. In addition, the towns of Kernville and Isabella are being destroyed. The town of New Kernville is already well on its way to boom status 5 miles north of its old location, and Isabella is to be rebuilt below the dam, probably with a new identity.

The lake that will be formed behind the Isabella Dam will be 8⅓ miles long, will cover 11,200 acres, and will have



PREPARING TO BLAST: Walsh Construction Company workmen direct the operations of drills mounted on a jumbo, preliminary to blasting a cut in the outlet portal.

IN THE SPILLWAY: Macco and Morrison-Knudsen wagon drill crews at work putting down holes for blasting the granite formation in the spillway section.

a shoreline of 38 miles. At capacity, the dams will create the largest artificial lake in southern California.

The primary purpose of the project is flood control, but the reservoir will also be used to store water for conservation uses during the dry season. Like other similar multiple-purpose structures, Isabella Dam will contribute to the benefit of agriculture through improved river flows.

Because the reservoir will be subjected to wide fluctuations, its usefulness as a recreational facility must be incidental to the main function for which it was designed. Under ideal conditions, the project should add one more attraction to an already interesting and beautiful countryside.

The need for Isabella Dam grew out of the unpredictable and erratic behavior of the Kern River. This turbulent and rock-bedded stream drains the southerly reaches of the Sierra Nevada. The annual flows vary from 1,900,000 acre feet of water to as little as 185,000 acre feet. The threat of floods from this river is bifurcate, the first being from unpredictable heavy winter rains, and the second from piled-up waters in the late spring runoff from melting snows.

Floods Delayed Work Progress

The floods which the dam is designed to control played a part in delaying completion of the work, when in November and December of 1950, raging waters from winter rains disrupted lining operations in the outlet tunnel. For this particular river, a flood maximum of 12,000 cu. ft. a second is considered quite severe. During the late 1950 flood, a peak of 30,000 cu. ft. a second surged down the channel. Bulkheads hastily thrown up around the tunnel portals were impossible to maintain, and the flood waters broke through, inundating the entire bore and jamming it with debris.

Work on the main dam outlet works was started in July, 1949, and completed in January, 1952. In addition to its permanent function as an outlet for pent-up waters, this unit serves as a diversion tunnel during construction. The construction of a valve chamber and a control tower were tied in with the driving of the tunnel.

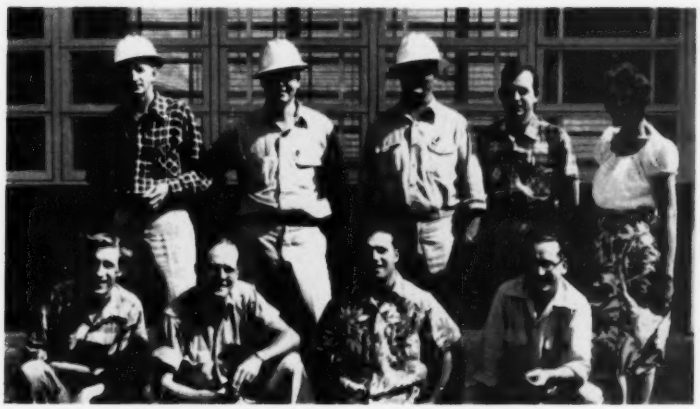
The bulk of the explosives required

AFTER A BLAST: Blasted rock is loaded out by a Northwest shovel operator into Euclid trucks for later use on the project as fill, aggregate, or riprap.

THE CORE TRENCH: For blasting in the core trench, holes are drilled 4 ft. deep on 1-ft. centers. Plugged holes in foreground show spacings.

CONTRACTOR'S KEY MEN: Left to right, Chris Nielsen, foreman of drilling and blasting; Dave Fletcher, superintendent of excavation; O. H. Tucker, project manager.

DIAMOND DRILLING: For construction of a grout curtain in the main dam cut-off trench section, holes were put down by means of diamond drills.



ARMY ENGINEERS' PERSONNEL: Front, left to right, Robert Weber and Gene Alba-de Costa, computers and draftsmen; Sam Nigro, office engineer; M. L. Rowland, computer and draftsman. Rear, left to right, H. J. Dickinson, project engineer; J. M. Chadick, assistant project engineer; Floyd Childs, chief inspector; L. C. Jacobson, administrative assistant; Mrs. Calelle Alba-de Costa, receptionist.

on the project was used in the construction of the outlet tunnel, the valve chamber, and the spillway. Some additional blasting was done to clear the foundation for the main dam.

Blasting Operations

For blasting in the tunnel, a modified pyramid cut was used with 45 to 60 holes in a round, 1¾ in. in diameter, averaging 8 ft. in depth. Each hole was loaded on a basis of approximately 4 lbs. of dynamite per cu. yd. of rock in the solid. The charges were primed with delay electric blasting caps. The leg wires of the caps were connected in parallel to a bus wire staked to the tunnel working face.

In addition to blasting the tunnel through granite in a hillside, explosives are playing a major part in the excavation work related to the main dam spillway and to the foundation of the main dam. To construct the spillway, 350,000 cu. yds. of material—mostly granite—is being blasted.

The spillway, 140 ft. wide at the crest, tapers down to 60 ft. where it disgorges into the channel of the Kern River below the dam. At its deepest point, the spillway is 90 ft. below grade. In the establishment of foundations for the auxiliary dam, no blasting was required. However, in the foundation work for the main dam, 30 per cent of the excavation required the use of explosives.

For blasting operations in the spillway section and main dam foundation area, the contractors used semi-gelatin grades of dynamite. The dynamite charges were primed with short-period delay electric blasting caps. Blasts were fired from a 440-volt power line, with the power supplied by Southern California Edison Company.

For blasting in the spillway, the depth of the drill holes in a round varied from 6 to 18 ft., spaced on 6-ft. centers, until the excavation approached the invert grade. To minimize the fracture of the invert rock, and to avoid excessive overbreak, the depth of the rounds and the spacing of the drill holes were reduced. In the main dam's foundation core trench, 2⅜-in. starter bits were used with a change to 1⅞-in. bits to drill 4-ft. holes on 1-ft. centers. In all phases of the

(Continued on page 192)

PETER KIEWIT

EDWARD P. PALMER

THE MOLES AWARDS FOR 1953

Peter Kiewit and Edward P. Palmer to receive bronze plaques and citations for outstanding contributions to constuction progress

THE Award Committee of The Moles, an association of prominent executives in the heavy-construction industry in the United States, recently announced that Peter Kiewit, president of Peter Kiewit & Sons Company, Omaha, Nebraska, and Edward P. Palmer, president of Senior & Palmer, Incorporated, New York City, will receive The Moles awards for 1953, for outstanding contributions to construction progress. The awards, bronze plaques and citations, will be presented at the thirteenth annual dinner-meeting of the association on Wednesday night, February 4, 1953, in the Waldorf-Astoria Hotel, New York City. Advance reservations indicate that more than 1,000 prominent contractors, engineers, and industrial leaders will attend the ceremonies.

Peter Kiewit, the nonmember recipient, learned bricklaying in high-school days. He gave up a college career at Dartmouth to go to work for his father's construction company in 1920, at the age of 20. Ten years later, he was made president of the company. During the following 22 years, the net worth of the company was increased from $500,000 to its present status of approximately $17,000,000.

Big and Little Jobs

During World War II years, the Kiewit Company, as an integral unit and in association with other contractors, was awarded contracts from the Government amounting to $300 million. The work ranged from Army camps in Colorado, Washington, and Oregon to landing fields along the Alcan Highway. It has contributed to the building of highways in Kansas and California, and big dams through the Missouri Valley. In 1951, the company's business rose to $150 million; it will exceed $200 million this year.

Two years ago, at the request of Army Engineers, Peter Kiewit formed a combine of his own choosing to do a hurry-up job in Greenland, designated "Operation Bluejay." The contract, a $100-million-plus project, involved building heavy-bomber airfields and housing for 400 men. At this writing, the work is well under way.

The most recent notable contract received by the Kiewit firm was the award by the Atomic Energy Commission of a $1.2-billion uranium plant construction project in southern Ohio. The plant, spread over 6,500 acres, will take four years to build. An average of 17,000 men will be employed on the various phases of the project during the four-year period. This means that the company will direct operations involving approximately $1,000,000 worth of work a day.

(Continued on page 194)

DON'TS

This is the latest revision of "Don'ts" adopted by the Institute of Makers of Explosives, May 5, 1951. It supersedes all previous lists of "Don'ts" issued by the Institute

For the purposes of this list of DON'TS, the terms contained therein shall be as follows:

The term "explosives" shall signify any or all of the following: dynamite, black blasting powder, pellet powder, blasting caps, and electric blasting caps.

The term "electric blasting cap" shall signify any or all of the following: instantaneous electric blasting caps, delay electric blasting caps, and delay electric igniters with blasting caps attached.

1. Don't purchase, possess, store, transport, handle, or use explosives except in strict accordance with organizational, local, state, and federal regulations.

2. Don't store explosives anywhere except in a magazine which is clean, dry, well ventilated, properly located, substantially constructed, and securely locked.

3. Don't allow persons under eighteen years of age to handle or use explosives, or to be present where explosives are being handled or used.

4. Don't leave explosives lying around where children can get them.

5. Don't allow leaves, grass, brush, or debris to accumulate within twenty-five feet of an explosives magazine.

6. Don't smoke or have matches, open lights, or other fire or flame, in or near an explosives magazine, or have them nearby while handling or loading explosives.

7. Don't shoot into explosives with any firearm, or allow shooting in the vicinity of an explosives magazine.

8. Don't store any metallic tools or implements in an explosives magazine.

9. Don't drop, throw, or slide packages of explosives or handle them roughly in any manner.

10. Don't open kegs or cases of explosives in a magazine.

11. Don't open kegs or wooden cases of explosives with metallic tools. Use a wooden wedge and wooden, rubber, or fibre mallet. Metallic slitters may be used for opening fibreboard cases, provided that the metallic slitter does not come in contact with the metallic fasteners of the case.

12. Don't store or leave packages of explosives which have been opened without replacing the cover.

13. Don't use empty explosives cases for kindling.

14. Don't permit any paper product used in the packing of explosives to leave your possession. Accumulations of fibreboard cases, paper case liners, cartons, or cartridge paper should be destroyed by burning after they have been carefully examined to make sure that they are empty.

15. Don't use explosives that are obviously deteriorated.

16. Don't attempt to reclaim or use fuse, blasting caps, electric blasting caps, or any other explosives that have been water-soaked, even if they have dried out. Consult the manufacturer.

17. Don't carry explosives in pockets of clothing.

18. Don't make up primers of explosives in a magazine or near excessive quantities of explosives.

19. Don't force cartridges of any explosives into a bore hole or past any obstructions in a bore hole.

20. Don't allow explosives, or drilled holes while being loaded with explosives, to be exposed to sparks from steam shovels, locomotives, or any other source.

21. Don't spring a bore hole near another hole loaded with explosives.

22. Don't load a sprung bore hole with another charge of explosives until it has cooled sufficiently.

23. Don't tamp with metallic bars or tools. Use only a wooden stick with no exposed metal parts.

24. Don't use combustible material for stemming.

25. Don't allow near the danger area of a blast any persons not essential to the blasting operations.

26. Don't fire a blast until all surplus explosives are in a safe place, all persons and vehicles are at a safe distance or under sufficient cover, and until adequate warning has been given.

27. Don't return to the face until the smoke and fumes from the blast have been dissipated by adequate ventilation.

28. Don't attempt to investigate a misfire too soon. Follow all applicable rules and regulations, or, if no rules are in effect, wait at least an hour.

29. Don't drill, bore, or pick out a charge of explosives that has misfired. Misfires should be handled only by a competent and experienced man.

30. Don't abandon any explosives. Dispose of or destroy them in strict accordance with the methods recommended by the manufacturer.

31. Don't store cases of dynamite so that the cartridges stand on end.

32. Don't leave dynamite, black blasting powder, or pellet powder in a field or any place where livestock can get at them.

33. Don't take surplus quantities of permissible dynamite, black blasting powder, or pellet powder into a mine at any one time. These explosives deteriorate rapidly in a damp atmosphere.

34. Don't use black blasting powder or pellet powder with permissible explosives or dynamite, nor dynamite with permissible explosives, in the same bore hole in a coal mine.

35. Don't tamp pellet powder in a bore hole hard enough to crush the pellets, because of danger of premature explosion.

36. Don't store blasting caps or electric blasting caps in the same box, container, or magazine with other explosives.

37. Don't leave blasting caps or electric blasting caps exposed to the direct rays of the sun.

38. Don't insert a wire, a nail, or any other implement into the open end of a blasting cap to remove it from a box.

39. Don't strike, tamper with, or attempt to remove or investigate the contents of a blasting cap or an electric blasting cap.

40. Don't try to pull the wires out of an electric blasting cap.

41. Don't connect blasting caps or electric blasting caps to Primacord except by

the methods recommended by the manufacturer.

42. Don't attempt to fire a circuit of electric blasting caps except by an adequate quantity of delivered current.

43. Don't use in the same circuit electric blasting caps made by more than one manufacturer.

44. Don't handle explosives during the approach or progress of an electrical storm. All persons should retire to a place of safety.

45. Don't make electrical connections without first making sure that the ends of the wires are bright and clean.

46. Don't allow electrical connections to come in contact with other connections, bare wire, rails, pipes, the ground, or other possible sources of current or paths of leakage.

47. Don't have electric wires or cables of any kind near electric blasting caps or bore holes charged with explosives except at the time of, and for the purpose of, firing the blast.

48. Don't use electric blasting caps in very wet work unless they have adequate water resistance and suitably insulated leg wires.

49. Don't use any means other than a blasting galvanometer containing a silver chloride cell for testing electric blasting caps, singly or when connected in a circuit.

50. Don't use damaged leading or connecting wire in blasting circuits.

51. Don't use duplex leading wire except for single shot firing.

52. Don't tamper with or change the circuit of a blasting machine in any way for any purpose.

53. Don't spare force or energy in operating a blasting machine.

54. Don't store fuse or fuse lighters in a wet or damp place, or near oil, gasoline, kerosene, distillates, or similar solvents.

55. Don't store fuse near radiators, steam pipes, boilers, or stoves.

56. Don't handle fuse carelessly in cold weather. If possible, it should be warmed slightly before using to avoid cracking the waterproof coat.

57. Don't use short fuse. Cut fuse long enough to extend beyond the collar of the hole and to allow time to retire safely from the blast. Never use less than 2 feet.

58. Don't cut fuse until you are ready to insert it into a blasting cap. Cut off an inch or two to insure a dry end.

59. Don't cut fuse on a slant. Cut it square across with a clean, sharp blade. Seat the fuse lightly against the cap charge and avoid twisting after it is in place.

60. Don't crimp blasting caps to fuse with a knife or with the teeth. Use a standard cap crimper and make sure that the cap is securely fastened to the fuse.

61. Don't use fuse and blasting caps in wet work without having a thoroughly waterproof joint between the fuse and cap.

62. Don't kink fuse in making up primers or in tamping a charge.

63. Don't hold the primer cartridge in the hand when lighting fuse.

64. Don't light fuse in any bore hole until the holes contain sufficient stemming to protect explosives from sparks from the end spit of fuse or a flying match head.

65. Don't try to light fuse with burning paper, other inflammable refuse, or improvised torches.

66. Don't light fuse near blasting caps or any explosives, other than those being used in the blast.

The Isabella Dam

(Continued from page 189)

job, the excavated material is stockpiled for use as fill, aggregate, or riprap.

Air for the jackhammers and wagon drills is supplied by Gardner-Denver 500-c.f.m. stationary electric compressors mounted at the top of the spillway. Gardner-Denver wagon drills, with the drill steel equipped with Timken carbide insert bits, are employed extensively. Northwest 80D power shovels are utilized in excavating the blasted rock and loading it into Euclid trucks.

About 350 men are employed by Macco and M-K in the final phases of the work, with an additional force of about 25 working out of the local Corps of Engineers' office. Smaller forces are employed in relocating the Borel canal, the telephone and power lines, and on highway construction.

Living Conditions

Most of the men employed on the project are living in homes, trailer courts, and cabins provided by the Government. Many of the homes had been occupied for more than half a century by old Kernville and Isabella families. For the single men, the contractors have taken over Mountain Inn, a radical departure from the usual barracks and mess hall arrangements found on many construction jobs. The inn, one of the landmarks in the area, has provided local color for many motion-picture companies that formerly headquartered in Kernville throughout the year.

The concept of a dam to control the turbulent Kern River, and to provide conservation storage, goes back many years. The first report on such a project was made by the State of California in 1931, concurrently with a Corps of Engineers' overall report on the nation's river and water resources, which included a survey of the Kern River problem. The Flood Control Act of 1936 authorized further studies be made because the continuing growth of Bakersfield, a city of 100,000 population, located 17 ft. below the river crest, was becoming the center of great industrial, petroleum, and agricultural development.

The construction of the dam was authorized by the Congress in the 1944 Flood Control Act. Exploration crews went to work in the area to determine the exact character of the earth down to the solid rock line. Subsequent developments proved the geologists' estimates to be correct in every detail.

Construction activities on the project began on March 16, 1948, and the completion date is now scheduled for about June 1, 1953. Present estimates indicate that the reservoir will be in operation for flood control and irrigation purposes about a month earlier.

Job Supervision

The overall project is under the supervision of Colonel C. C. Haug, district engineer, and J. R. Morton, chief of operations, Corps of Engineers, Sacramento district. The Corps' resident engineer is H. J. Dickinson. Associated with him are James M. Chadick, assistant project engineer; Floyd Childs, chief inspector; Sam S. Nigro, office engineer; and Lee C. Jacobson, administrative assistant.

For the contractors in this joint venture, O. H. Tucker is project manager, assisted by E. R. Hargraves, office man-

ager; Dave Fletcher, excavation superintendent; Chris Nielsen, drilling and blasting foreman; and Lex Hobson, master mechanic.

The personnel of Walsh Construction Company on the tunnel excavation job included L. E. Huntington as general superintendent; O. Holman, superintendent; J. M. Saliday, office manager; and R. W. McAvoy, master mechanic. On the tunnel-lining job, the project manager for H. C. Smith Company was Stanley Kimball, with Jerry Fox as superintendent of operations; W. J. Burke, rigging foreman; H. R. Williams, concrete foreman; and Alexander Bataiff, job engineer.

Union Pacific's Coal Miners

(Continued from page 185)

feel that he is king in the coal-mining program of The Union Pacific Coal Company.'

"Your many victories in the National Safety Competition," the speaker continued, "and your many awards of the Sentinels of Safety trophy are the rewards of vigilance. This is the reward of organization, of education, of recognition of the individual as an individual, and as an enthusiastic member of the entire team."

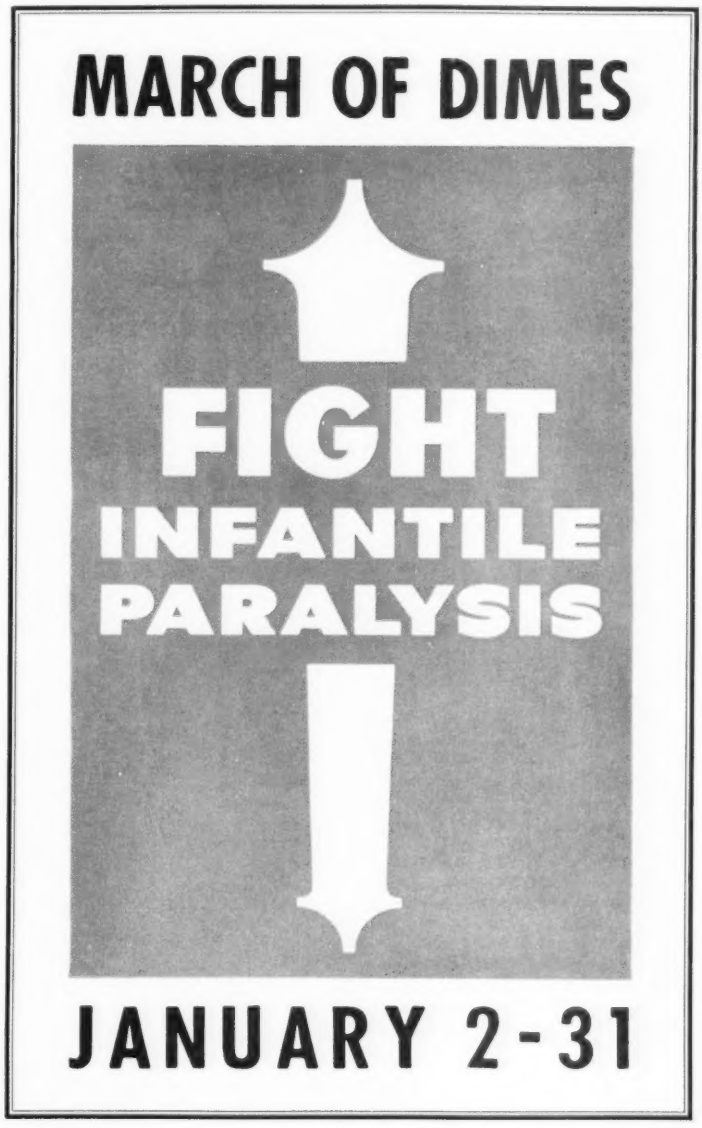
At the conclusion of his remarks, Mr. Marvin awarded the Sentinels of Safety trophy and flag to I. N. Bayless, president of the coal company. Mr. Bayless, in turn, presented them to Milton Friel, duckbill operator at Reliance No. 7 mine.

Cooperation

In accepting the trophy and flag on behalf of his mine associates, Mr. Friel said, "They are emblems of the cooperative effort of employer and employe thinking and practicing safety at all times. We hope that the example of safety in operations at Reliance No. 7 mine will encourage other mines to redouble their efforts to eliminate lost-time injuries through alert and progressive safety procedures."

The toastmaster then called upon James Westfield, chief of the Health and Accident Division, U. S. Bureau of Mines, to present individual Certificates of Achievement in Safety to the Reliance employes. Mr. Westfield commended the miners for their victory in the 1951 nation-wide safety contest. "Not only did your record last year top all others in your group, but you have won highest honors for four straight years. During those four years, you have worked a grand total of 1,684,394 man-hours without a disabling accident. That is truly an amazing record in accident prevention in underground coal mines. You and your associates have every right to be mighty proud folks." Mr. Westfield presented the certificates to Mr Bayless who, in turn, called upon Lawrence Welsh, superintendent of Reliance No. 7 mine, to take charge and distribute them later to each of his associates.

Following brief remarks by E. H. Denny, chief of Region No. 4, U. S. Bureau of Mines, and Lyman Fearn, state coal mine inspector for Wyoming, the ceremonies were ended by the pronouncement of benediction by the Reverend William Delaney.



THE 1953 MOLES AWARD

(Continued from page 190)

Edward P. Palmer, the member recipient, has been active in the heavy-construction field for 46 years. In association with his company, he has participated in the building of the Seventh and Eighth Avenue subways in New York; the foundations for numerous bridges, including the George Washington span over the Hudson River; and, at present, on substructure work on New York Central Railroad Company's new Harlem River crossing. The Senior & Palmer firm is expert in pneumatic caisson work, one of the most difficult of all construction operating requirements.

Longtime Crusader for Construction Progress

For many years, Mr. Palmer has been recognized as a powerful force in the promotion of activities directed toward the improvement of conditions under which construction organizations have to operate. He was a member of the Contractors Code Authority in NRA days; is a 13-year member of The Associated General Contractors of America—a past president and a former chairman of its Labor Relations Committee; a member of an advisory committee on construction matters to the Munitions Board; a director of the Chamber of Commerce of the United States for six years; and an industry member on the National Joint Board for the Settlement of Jurisdictional Disputes in the Construction Industry.

Edward P. Palmer was graduated from Swarthmore College in 1906, and has served as a member of the college's board of managers. He is a member of the board of trustees of Seabury Memorial Home, Mt. Vernon, New York; a member of American Society of Civil Engineers; and is secretary-treasurer of the Transportation Corps (A.E.F.) Association. In World War I, he was a captain in the Army Transportation Corps, with service in France.

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● McCarthy Vertical Drills adapt to any job where ordinary rock formations are to be blasted.

Designed with compact retractable hydraulic tower for Truck, "Cat," Half-track or Jumbo mountings. Power shafts made of tough alloy steel. Simplified construction throughout.

Over-all height with tower reclining: 7 ft., 4 in. Wt.: 5,100 lbs. All McCarthy units can be operated with Gasoline, Diesel or Electric power units. Write for descriptive literature.

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The I-R QUARRYMASTER speeds blast-hole drilling in any kind of rock

High drilling speed, low bit cost, minimum labor requirements, low service truck charges—these are but a few QUARRYMASTER advantages that give you the lowest possible drilling cost per ton. Fast drilling speeds mean more holes per day permitting closer hole spacing for better fragmentation. The result is increased primary crusher efficiencies and reduced costs on loading and hauling equipment. Compare these features with any other drill rig.

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Whatever power you select for your Bucyrus-Erie drill — gasoline, electric, diesel — you are assured of a big, heavy-duty unit that easily handles the heaviest tool strings in the drill's size range. Efficient application of power keeps fuel or current consumption low.

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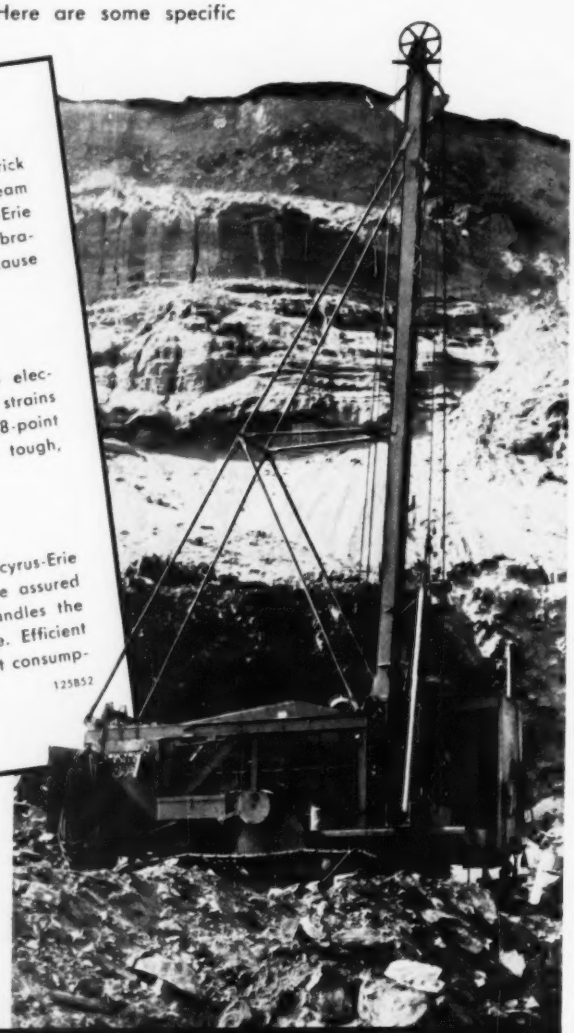

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Using Primacord you get faster, easier loading; the positive firing of every dynamite cartridge in every hole – be they wet or dry; the shooting of as many holes as you wish; the most efficient use of your men and mobile equipment regardless of the terrain or the weather. And correctly hooked up, you can shoot the front holes a split second ahead of those behind, giving you relief from burden and better fragmentation. All of which means easier digging, larger daily yardage.

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Ask your explosives supplier or write us direct for further facts

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There's a type for every job. **PLAIN PRIMACORD** for shallow holes and surface trunk lines; **REINFORCED PRIMACORD** for deep holes and resistance to abrasion; **WIRE COUNTERED PRIMACORD** for deep, ragged holes; and **PLASTIC REINFORCED PRIMACORD** for deep holes and unusual wet conditions.

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Hercules' research has developed explosives that shoot successfully even under the severe water pressures encountered today in seismograph prospecting.

In the laboratory test shown here, a cartridge of Hercules Vibrogel* 3 is sealed in the steel "bomb" at the extreme left. It then undergoes prolonged exposure to pressures greater than those ordinarily found in actual field use. Because Vibrogel 3 embodies a new conception of explosives research, it detonates despite these extreme conditions.

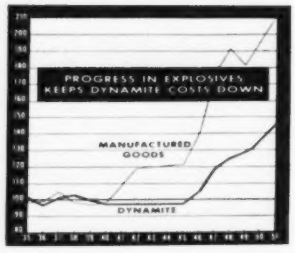

Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods. 1935-39 values=100.

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Available in 1⅞" and 2⅛" feed cylinder diameters, and with 36" and 48" feed travel, the Airleg is ideal for use with CP Sinkers, particularly the general utility, 45 lb. class CP-32 and the 55 lb. class CP-59.

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New Le Roi 125 cfm Airmaster at work cutting costs. The two model 52 Le Roi-CLEVELAND breakers get plenty of air, break concrete faster, and reduce the time spent on the job. You save.

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New 85 cfm— Perfect as a "one-gun" compressor. Operates heavy breaker and other tools that are too much for 60 cfm units. Here we see one operating the handy 17½-lb. Le Roi-CLEVELAND H-22 sinker.

New 125 cfm — Both gas and diesel models. Ideal for running two heavy breakers, such as these Le Roi-CLEVELAND Model 52's, from one machine. Priced the same as the old 105-cfm gas and diesel units. A low-priced liquid-cooled 105 is still available to meet your needs.

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- New! 185 cfm gas
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- 210 cfm gas
- New! 250 cfm diesel
- New! 365 cfm gas
- New! 365 cfm diesel
- 600 cfm diesel (IHC)
- 600 cfm diesel (Murphy)
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NOW you can get more air capacity for less money! Now you can match your job requirements *exactly* with the portable compressor that lets you do the most work at the least cost! For now, thanks to Le Roi's expanded Airmaster compressor line, you have the industry's widest range of sizes to choose from!

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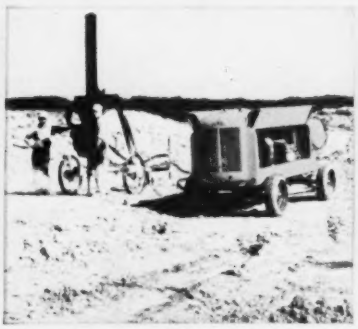
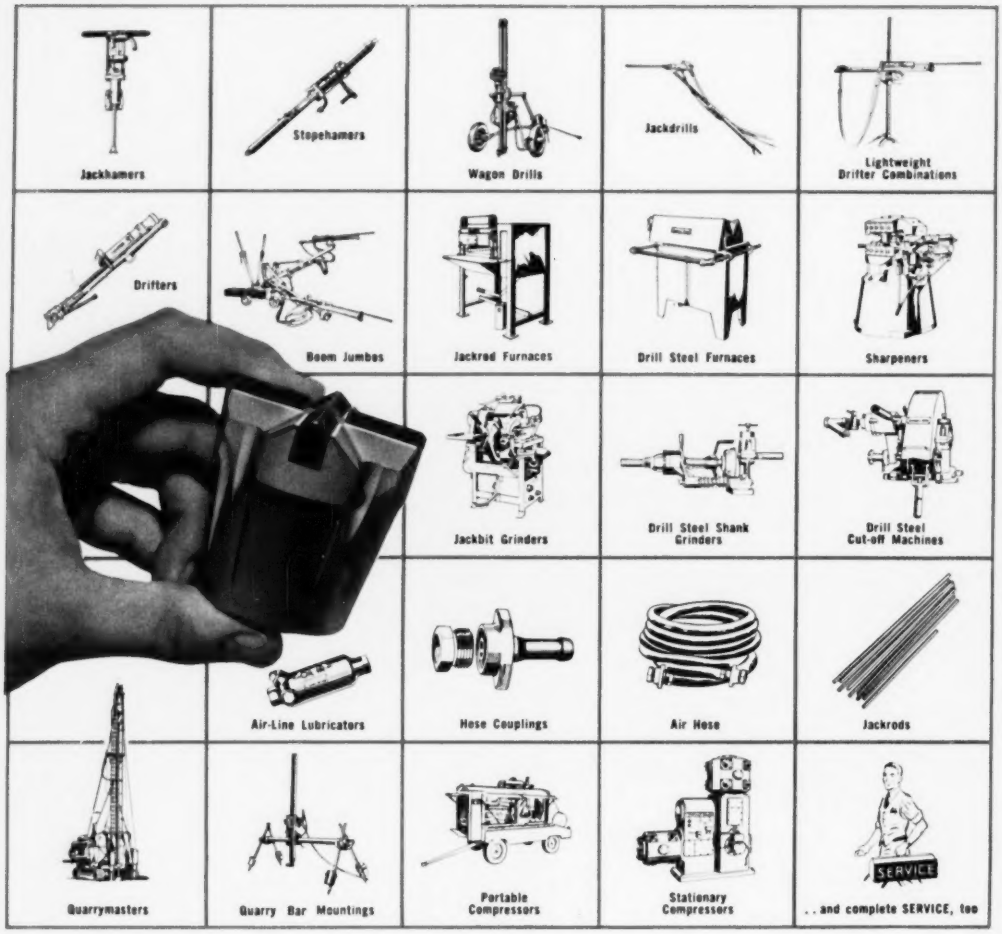


New 365 cfm — Gas and diesel units replace 315-cfm models. Extra capacity handles many applications that formerly required a 500. Here it runs a Le Roi-CLEVELAND DR-30 wagon drill for deep holes.

600 cfm — These heavy-duty diesel units have plenty of capacity to help you get extra footage from your wagon drills and hand-held tools. The 600 shown here operates two Le Roi-CLEVELAND DR-30 deep-hole wagon drills with plenty of air to spare for other tools.



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